

*A Reader of Gesture-Based Accessibility User Interface Design for Visually Impaired Children*

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**Abstract**

A mobile application, called READ, is developed in this paper to provide visually impaired children more friendly way of reading. This system includes accessible mobile app and book library in the cloud. In Taiwan, there is a special kind of books designed for children, which contains both braille and print characters on the same page. This kind of books is very useful for visually impaired children who start learning braille and their sighted parents or teachers can read with them. The proposed app is designed to assist visually impaired child in reading this kind of books. When visually impaired children get a book on the bookshelf, at home or in a library, they can scan the barcode on the book by the camera on the smart phone, then the proposed app READ will download the content in the cloud library and start reading the book with text-to-speech (TTS) technology to children. A non-directional barcode scanning technology is designed in the proposed app for fast recognition, and thus the barcode does not have to be focused and straight in the camera screen. Furthermore, unlike the common design concept that is based on buttons, gestures become the mainly user interface for visually impaired people. Users do not need to find the position of the buttons. Using gesture-based design the whole touch screen is the sensing area, which is more convenient and friendly for visually impaired children.

Keywords: accessibility user interface, visually-impaired children, gesture

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## **Background**

There are 56,000 persons with vision impairment in Taiwan, but only small parts of them, especially children, know how to use braille. Most visually impaired children are not familiar with braille and computers, and thus family members, teachers, or volunteers have to read for them. However, this way cannot be available to them around the clock. Another way to read is to listen to audio books. But recording audio books usually take a long time, and the volume of available audio books is limited. To provide visually impaired children an alternative way of reading, to enhance their skill to use braille, and to promote parent-child co-reading activities, we design and implement an APP, called READ, and a cloud library, to offer visually impaired children an alternative way of reading and promote parent co-reading activities.

Voice Over is a screen readers built in Apple's iOS system, which is classified as an accessibility feature for people with vision impairment. You can easily manipulate it with simple gestures on your iOS devices. Voice Over can use braille keyboard, which supports 6 dot and 8 dot braille, without third-party entities. Voice Over works with built-in iPhone apps, but not all commercial apps. It's a very useful function for the visually impaired people. Please refer to APPLE Website (<http://www.apple.com/accessibility/iphone/vision/>).

In Taiwan, there is a special kind of books designed for children, called dual-view book here, which contains both braille for the blind and print characters for the sighted person on the same page. This kind of books is very useful for visually impaired children who start learning braille and their sighted parents or teachers can read with them. Dual-view books can make teacher understand the reading situation of visually impaired students, and give them timely guidance. Therefore, the braille books can realize the co-reading activities.

## **Research methods**

The proposed app, READ, focuses on visually impaired children mainly. Even youth children can acquire how to use it. The app READ runs on iOS system, and can be downloaded from Apple Store. Eduardo Ghidini, Wagner D. L. Almeida, Isabel H. Manssour and Milene S. Silveira (2016) indications that interfaces that provide different forms of interaction, such as voice, touch and vibration, do facilitate the use of applications for the visually impaired. With friendly interface and voice guidance system, visually impaired children can use READ without parents' help. The visually impaired children can listen to the books they want with this APP. In addition, the parents can use the recording function of the app to make audio story with their own voice for their child to accomplish the purpose of parent-child reading. David McGookin, Stephen Brewster and WeiWei Jiang (2008) said touchscreen computing devices such as the iPhone are becoming more common. João Oliveira, Tiago Guerreiro, Hugo Nicolau, Joaquim Jorge and Daniel Gonçalves (2011) said good spatial ability is still required to have notion of the device and its interface, as well as the need to memorize buttons' positions on screen. These abilities decay especially for young or old people. Therefore, the operation concept of the proposed app READ is based on gestures instead of buttons. As whole touch screen is the sensing area, users don't need to focus on the position of a button anymore. Button-based user interface is not friendly for visually impaired people, especially young children who

seldom use the smart phone. It usually takes a long time to find a button on the screen, while they need to memorize the position of each button, tap on the correct location, and listen to the guidance before using it. This process is very inconvenient, and need a lot of time to adapt it. On the contrary, in the proposed gesture-based app READ, the whole touch screen is a sensing zone. The visually impaired people don't need to memorize the position of each button, which is more convenient and friendly.

## Research results

The proposed app READ run on iOS 6.0 and can be free downloading from Apple's App Store. Cooperating with Taiwan National Library of Public Information, the app links to the library's book database for the blind. This app has voice guidance assisting the visually impaired children in using the app by themselves. When the child wants to read a book, they can use this READ to scan the barcode on the book. READ will automatically connect to the library's book database, download the book's text file and play this book with text-to-speech (TTS) technology. READ also has a recording function, where parents or teachers can use this to record an audio book for their children or students. Then children can choose either TTS or audio made by parents or teachers to listen to the book. In addition, if there are volunteers who had recorded audio books stored in the database, children can also choose the audio version.



Figure 1. The main page.

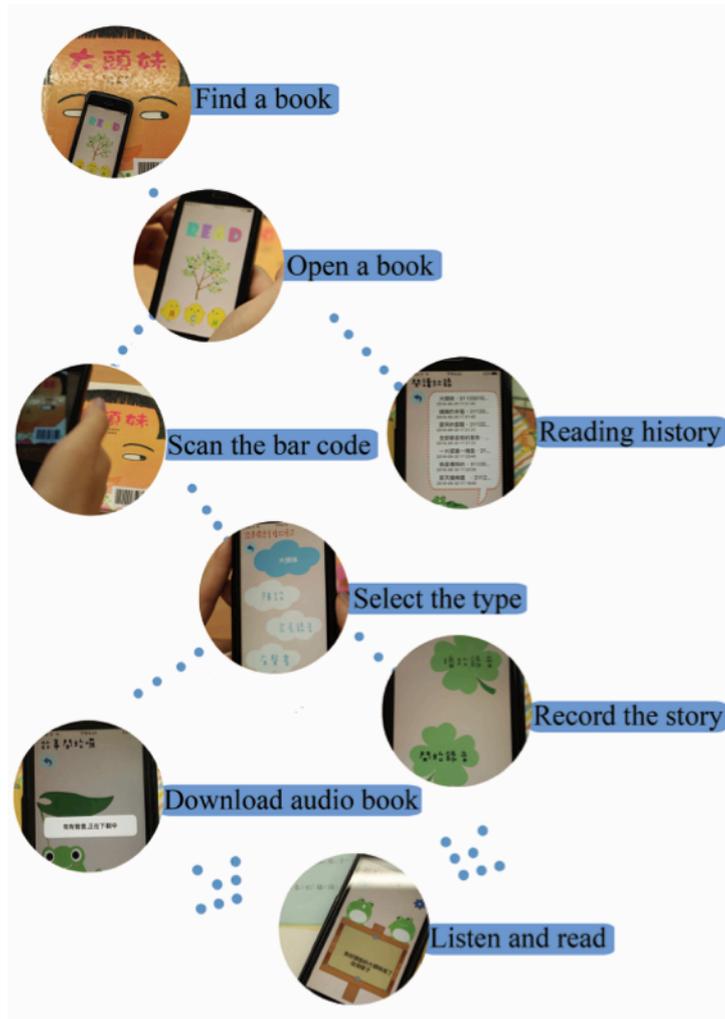


Figure 2. An example of using READ.

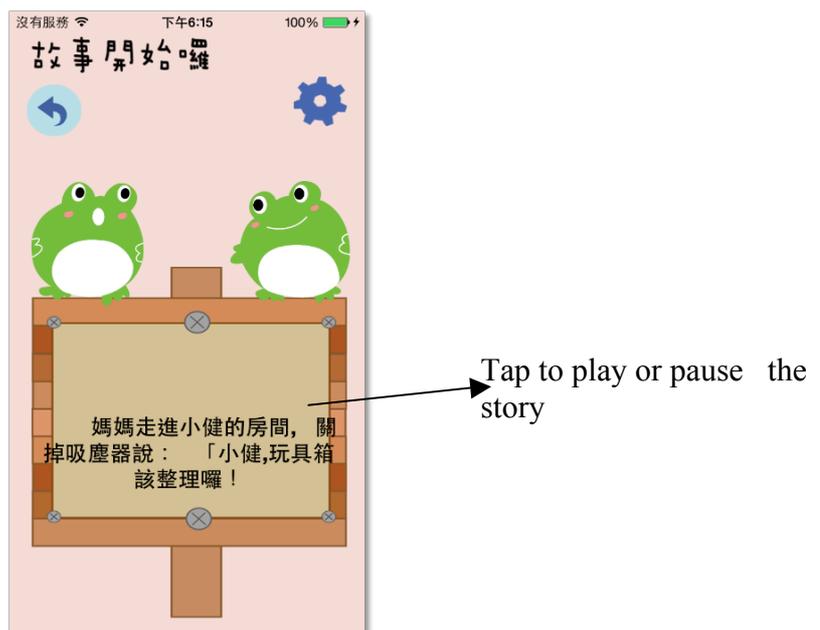


Figure 3. Enter the reading page

READ provides three main functions, scanning a barcode (tap the tree as shown in Figure 1), reading history (tap the 'H' as shown in Figure 1) and recording a story (tap the 'R' as shown in Figure 1). First, users need to log-in to use this app. Secondly, use READ to scan a book's barcode, and then the app will download the text file from the database, and start to play the book with text-to-speech (TTS) technology. We use a non-directional barcode scanning technology, and thus as long as the barcode is in the range of the camera, it can scan successfully. Figure 2 illustrates an example of using the proposed app READ.

Gesture		Action description
	Double tap	Open the book
	slide up	Increase pitch or Speak speed
	slide down	Decrease pitch or Speak speed
	Tap	Play or pause
	Two fingers slide to the left	Go to the previous sentence
	Two fingers slide to the right	Go to the next sentence

Figure 4. The gestures provided in READ.

In the playing page, as shown in Figure 3, the app plays a book sentence by sentence, with both words shown on screen and voice generated by TTS. When you tap on screen, the audio pauses; when you tap again, it continues. You can also go back to the previous sentence or jump to the next sentence any time by touching the screen with gestures. There are six gestures provided in this app, and different gestures indicate different actions, which are shown in Figure 4.



Figure 5. Reading history.

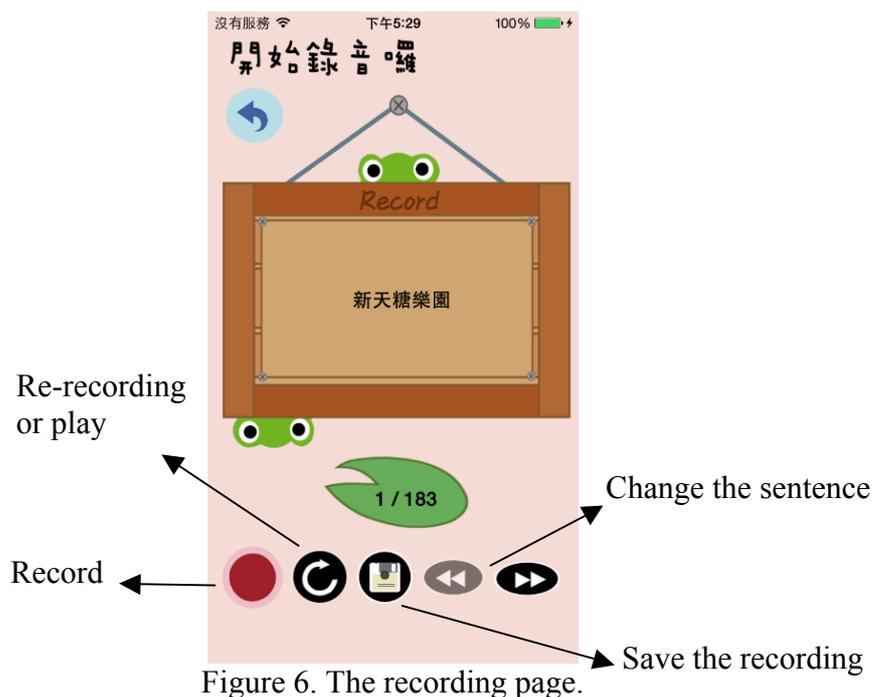


Figure 6. The recording page.

Reading history, as shown in Figure 5, allows parents to know which books the children had read, how many times they read this book, and the last time they read this book. When you double tap one entry, READ will open the book and go to the playing page automatically. Therefore, children can easily access and read the recent books again.

The recording function provides sentence by sentence recording feature, which parents can easily record an audio book. The recording page is shown in Figure 6.

## **Conclusions**

The traditional button-based user interface design is very inconvenient for visually impaired people. Therefore, the proposed app READ uses gesture-based interface design, where the whole touch screen is the sensing area, and the visual impaired children can control the app more easily and accessibly. Using this app, visually impaired children can scan the barcode on the book borrowed from the library and read the book easily. Additionally parents can record audio books for their child, which encourages children reading more. The app is now available at Apple's app store (<https://itunes.apple.com/tw/app/shuang-shi-shuo-shu/id989049054?l=zh&mt=8> ).

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APPLE website : <http://www.apple.com/accessibility/iphone/vision/>.

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